

GRANT FINAL REPORT

Program Element: NASA Living With a Star
NASA Award: NAG5-10850
Title: Superposed Epoch Analysis of Ring Current Geoeffectiveness
Related to Solar Wind and Plasma Sheet Drivers
PI: M. W. Liemohn
Coinvestigators: J. U. Kozyra, M. F. Thomsen, J. E. Borovsky
NASA Technical Officer: Dr. Madulika Gahurthakurta

Dear Dr. Gahurthakurta,

This letter is to inform you of our activities supported during the 3 years of this grant.

The goal of that proposal was to examine the relationship between solar wind drivers and ring current dynamics through data analysis and numerical simulations.

The data analysis study was a statistical examination (via superposed epoch analyses) of a solar cycle's worth of storm data. Solar wind data, geophysical indices, and geosynchronous plasma data were collected for every time period with $Dst < -50$ nT from 1989 through 2002, and the storm list now exceeds 400 entries. This work was first conducted by a summer undergraduate student, Mr. John Vann (University of Kansas), with funding from the NSF Research Experience for Undergraduates program. It was then continued by a University of Michigan graduate student, Mr. Jichun Zhang. Mr. Zhang is now in his fourth year at U-M and is progressing very well toward a PhD in space science. His dissertation will be based on his data analysis and modeling efforts using this geomagnetic storm database.

The results of the data analysis study have been the focus of several conference presentations, and the first manuscript has just been published. Two additional papers are presently being prepared, one on average (superposed) solar wind features for various storm subsets (e.g., intense storms at solar maximum), and another on geosynchronous plasma features for these same storm subsets. The latter result was highlighted by the TR&T program director in his presentation at the COSPAR meeting this summer [*Sibeck*, COSPAR04-A-01536, 2004].

The theoretical study was an examination of ring current simulation results (from our kinetic ring current model, RAM) to understand the linkages between solar wind drivers and the inner magnetospheric response. We are emphasizing comparative storm analysis, often considering many storms at once, and sometimes employing superposed epoch analysis to examine the numerical results. This effort includes studies of the asymmetry of the ring current, the saturation of the ring current, the ring current's influence on the subauroral electric field configuration and the storm-substorm relationship. These studies have deepened our knowledge of the response of the ring current to interplanetary disturbances, and have laid a foundation for interpretation of the storm database analysis.

Our co-investigators at Los Alamos have also been busy working on this grant. They have continued to process and compile data from the magnetospheric plasma analyzer (MPA) instruments on the geosynchronously orbiting satellites their lab operates. They are producing

local time-universal time (LT-UT) color plots of various MPA parameters. Combined with our data sets, we have at our disposal a robust collection of measurements for the examination of the coupling between the stormtime ring current, the near-Earth plasma sheet, and the solar wind.

We have actively disseminated our scientific results to the community throughout the grant period. A large number of papers have been published with either full or partial support by this grant. We have also made dozens of presentations at scientific conferences and departmental seminars during the last 3 years. A listing of titles for these references is given at the end of this report.

To increase the communication and collaboration with our LANL co-investigators, Dr. Liemohn traveled to Los Alamos in March of 2003. He spent 3 days discussing all aspects of this work with Drs. Thomsen and Borovsky, as well as several meetings with other LANL researchers interested in the results of this work. While there, he gave a presentation to their group at their weekly seminar.

Thank you for supporting us in this endeavor. It was our pleasure to serve NASA and the scientific community with investigations of the near-Earth space environment.

Sincerely,

Michael Liemohn

Papers Fully or Partially Support by the Grant:

- Borovsky, J. E., R. J. Nemzek, C. W. Smith, R. M. Skoug, and C. R. Clauer, The solar-wind driving of periodic substorms and global stormtime sawtooth oscillations: What determines the periodicity, submitted to *Ann. Geophys.*, 2004.
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